# Dietary Protein Effect on Parakeet Reproduction, Growth, and Plasma Uric Acid

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The effect of dietary protein level on reproductive performance, chick growth, and plasma uric acid in parakeets was studied. The treatments consisted of three isocaloric diets (3200 kcal of metabolizable energy per kilogram) containing 13.5%, 18.2%, and 25% protein (analyzed) and a vitamin and mineral supplemented commercially available seed diet (13.4% protein, analyzed). One hundred five pairs were assigned to four dietary treatments. Twenty-nine pairs were assigned randomly to each of the isocaloric diets, and 18 pairs to the supplemented seed diet. Protein level had no effect ($P > .05$) on number of eggs laid, number of fertile eggs, or number of chicks hatched in any of the diets tested. However, number of chicks weaned per pair was lower ($P < .05$) in pairs fed the supplemented seed diet. Growth of chicks, at 7, 21, and 35 days of age was similar ($P > .05$) among the four dietary treatments. Blood was taken from breeders at the start and end of the trial, and from chicks at 21 days of age. No differences ($P > .05$) were seen in plasma among breeders fed isocaloric diets with different protein levels. Breeders on the supplemented seed control had a higher ($P < .05$) plasma uric acid at the end of the trial than those fed the other diets. No differences ($P > .05$) were observed in plasma uric acid between chicks from parents fed the isocaloric diets with different protein levels, but chicks from breeders fed the supplemented seed diet had higher ($P < .05$) levels than chicks from breeders fed the other three diets.

Key words: parakeets, protein, reproduction, growth, uric acid

## INTRODUCTION

The incidence of gout (visceral and articular) in pet birds has been speculatively blamed on high protein levels in diets. Gout in birds can be in two forms, each with a different origin. Visceral gout is the more common form in poultry. In visceral gout, plasma uric acid levels are high and urates are deposited in visceral organs. Sillers (1959) suggested that this form of gout is the result of physiological changes in the kidneys, which affect kidney function in general. Visceral gout has been nutritionally induced experimentally in chickens by feeding diets deficient in vitamin A (Elvehjem and Neu, 1932), and by diets containing excess calcium (Shane, 1969). Articular gout is characterized by the accumulation of urates in synovial capsules and tendon sheaths of joints. Articular gout has been experimentally produced, only in chicks genetically prone to this disease, by feeding very high protein (80%) diets (Peterson et al., 1971). These researchers demonstrated that the incidence of articular gout was highly influenced by heredity. Both visceral and articular gout in birds are associated with elevated plasma uric acid. However, according to Schlumberger (1969) , these two conditions are separate entities and do not occur together.

Uric acid is the main end product of nitrogen metabolism in birds, accounting for approximately 80% of the nitrogen excreted (O'Dell et al., 1960). Thus, the uric acid content in blood should be influenced by dietary protein, protein quality, nutritional state, and protein metabolism. Okumura and Tasaki (1967) reported that plasma uric acid levels rose dramatically after 72 hours of fasting. These researchers fasted White Leghorn cockerels (2 kg) for up to 240 hours. They found little change after 48 hours of fasting, but by 72 hours after the fasting started, the plasma uric acid level was 10 times higher than initial (70 versus 8 mg/100 ml). By 240 hours after fasting began, the uric acid level in plasma was 251 mg/100 ml. This high plasma uric acid would indicate an increased catabolism of tissue protein during starvation. Miles and Featherston (1974) used plasma uric acid content to determine amino acid requirements and protein quality, and found the method to be comparable to the use of weight gain break point analysis.

The objective of this experiment was to determine the effect of protein level on growth, reproduction and plasma uric acid in parakeet breeders and chicks.

## MATERIALS AND METHODS

Four dietary treatments were tested. The treatments consisted of 3 isocaloric (3200 kcal of metabolizable energy per kilogram) diets formulated to contain 13%, 18%, and 24% protein (Table 1 ). These isocaloric diets were extruded and made into a 5/64" round particle. The fourth diet consisted of a commercial parakeet seed mix supplemented with vitamins (Avitron, Lambert Kay) in the water and minerals (Bird Banquet Mineral Block). The seed mix consisted of a commercial mix containing white millet, canary seed and hulled oats. Upon analysis, the dietary protein was found to be 13.5%, 18.2%, and 25% in the extruded isocaloric diets and 13.4% in the supplemented seed mix. The extruded isocaloric diets were corn-soy based diets, with a constant addition of vitamins and minerals. Key amino acids (methionine, total sulfur amino acids, lysine, threonine, and tryptophan) were increased in direct proportion to the increase in protein. The levels of these amino acids in the 13% protein extruded isocaloric diet were formulated to be: .65%, .48%, .78%, .50%, and .16% for lysine, methionine, total sulfur amino acids, threonine, and tryptophan, respectively. The seed mix was calculated to contain: .32%, .15%, .32%, .41% and .21% lysine, methionine, total sulfur amino acids, threonine, and tryptophan, respectively. Other nutrients are shown in Table 1.

One hundred five pairs of parakeets (proven and unproven pairs) were assigned to four dietary treatments based on a randomized block design. Twenty-nine pairs were assigned to each of the 3 extruded isocaloric diets and 18 pairs to the supplemented seed diet. The blocks used were location within the room and previous breeding history.

TABLE 1. Analyzed nutrient levels of the diets (on an as is basis)

| Diet<br>Calculated<br>Protein, % | A<br>13.0 | B<br>18.0 | C<br>24.0 | D<br>ND |
|---|---|---|---|---|
| Moisture, % | 7.41 | 7.69 | 7.23 | 9.5 |
| Protein, % | 13.5 | 18.2 | 25.0 | 13.4 |
| Fat, % | 6.38 | 6.77 | 6.50 | 4.19 |
| Crude Fiber, % | 5.10 | 1.95 | 1.66 | ND |
| Calcium, % | 0.92 | 0.96 | 0.97 | ND |
| Phosphorus, % | 0.68 | 0.71 | 0.72 | ND |

ND=Not determined

The diets were analyzed for: dry matter by drying for 48 hours at 70 C in a force draft oven; fat by petroleum ether extraction after acid hydrolysis (Association of Official Analytical Chemists (AOAC), 1980); nitrogen by the micro-Kjeldahl method (AOAC, 1980); and protein calculated by multiplying the percentage nitrogen by 6.25 (AOAC, 1980); calcium by atomic absorption spectroscopy (AOAC, 1984); and phosphorus by colorimetry (AOAC, 1984).

Birds were housed in commercial small bird cages (18x 18"). Nest boxes (8x6") and nesting material (autoclaved burlap strings approximately 4" in length) were provided a week before the start of the experiment. Lights were slowly taken from 9/15 hour light/dark cycle to 15/9 hour light/dark cycle over 39 days. The experiment was started 7 days prior to the end of the light switch over. Birds were slowly switched to the breeder diet (over a 10 day period) starting 4 weeks prior to the start of the experiment. The experiment lasted 24 weeks or up to 3 clutches per pair, whichever came first.

Breeder birds were weighed at the start of the experiment and after 24 weeks or after 3 clutches (whichever came first). The nest boxes were checked daily; any eggs laid in the previous 24 hours were labeled with the date they were laid, and any new hatches were recorded daily. Any eggs that were determined infertile after 12 days were removed from the nest. Chicks were weighed daily from hatch to 35 days of age. Chicks were weaned between 35 and 40 days of age. Blood (1 cc) was taken from the jugular at 21 days of age in chicks, and at the start and end of the experiment in the breeders. The blood was placed in heparinized tubes, spun down and plasma removed for immediate analysis. Plasma was analyzed for uric acid by using a Cobas Serum Chemistry Analyzer and a Roche reagent for uric acid (kit number 292, Roche Diagnostic Systems, Inc., Nutley, NJ 07110).

Data were analyzed statistically by the general linear model (GLM) using the Statistical Analysis System (SAS, 1985) program. Where applicable, orthogonal contrasts were done to determine differences between treatment means.

**RESULTS AND DISSICUSSION**

Breeding and growth performance results are shown in Table 2. The diet had no significant effect ($P > .05$) on number of eggs per pair, number of fertile eggs per pair, and number of hatched chicks per pair. However, a numerically lower number of eggs, fertile eggs, and hatchlings were produced per pair in the supplemented seed diet than in the extruded isocaloric diets. Pairs on the supplemented seed diet weaned a lower ($P < .05$) number of chicks per pair than pairs on the extruded isocaloric diets.

The breeding performance observed in this study seems to indicate that a 13.2% protein diet, with the specified amino acid content, will support a reproductive performance as high as that supported by an 18.2%, and a 25% protein diet. It is important to note that the amino acid levels used, expressed as a percent of protein, are higher than those recommended by the National Research Council (NRC, 1984) for broilers. Protein and amino acid requirements have not been established for parakeets. Limited information is available about the nutrient requirements of parakeets (Earle and Clarke, 1991). Chicks were parent raised and had access only to the feed provided to them by their parents. Chicks from breeders fed the low protein (13.5%) diet grew as well as those from breeders fed the higher protein diets. These results would indicate that protein requirements for growth in parakeets are low as long as certain amino acid levels are met. The amino acid levels used in the low protein diet may serve as a starting point in determining amino acid requirements since the amino acid requirements for parakeets have not been determined.

TABLE 2. Breeding performance and growth of parakeets

| Diet Protein, % | A 13.5 | B 18.2 | C 25.0 | D (seed) 13.4 | SEM[1] |
|---|---|---|---|---|---|
| Number egg/pair | 15.2 | 14.1 | 15.2 | 12.2 | 1.3 |
| Number fertile/pair | 10.4 | 10.7 | 10.1 | 7.2 | 1.2 |
| Number hatched/pair | 7.8 | 7.2 | 7.9 | 5.9 | 1.0 |
| Number weaned/pair | 5.7[a] | 5.0[a] | 5.6[a] | 3.0[b] | 0.8 |
| Chick wt, grams | | | | | |
| 7 days | 12.4 | 13.2 | 13.6 | 12.3 | 0.6 |
| 21 days | 39.0 | 39.6 | 39.7 | 39.5 | 1.3 |
| 35 days | 40.2 | 8.4 | 39.4 | 40.7 | 1.8 |

[1] SEM, % Standard error of the means.
[a-b] Numbers within a measurement (row) with a different superscript letter differ ($P<.05$) significantly.

No differences ($P > .05$) in plasma uric acid were observed among breeders assigned to the different diets at the start of the experiment. At the end of the 24 weeks breeding season the plasma uric acid was similar ($P> .05$) among breeders fed the different extruded isocaloric diets containing different protein levels. However , the breeders fed the supplemented seed diet had a higher ($P < .05$) plasma uric acid than the breeders fed any of the other diets. Similar results were seen with the chicks at 21 days of age. Plasma uric acid was higher ($P < .05$) in chicks from breeders fed the supplemented seed diet than in chicks from breeders fed the extruded isocaloric diets, irrespective of protein level. No differences ($P > .05$) were seen among chicks from breeders fed the different protein level extruded isocaloric diets.

Seeds alone tend to be deficient in specific amino acids, as well as vitamins and minerals (Ullrey et al., 1991 ). The seed diet was supplemented with a vitamin mix (in the water) and a mineral block. However, no supplemental amino acids were given. Miles and Featherston ( 1974) found plasma uric acid levels to be an accurate method for determining amino acid requirements, and concluded that plasma uric acid could be used to determine protein quality in birds. The seed diet fed in this trial was probably marginal and/or deficient in amino acids. These deficiencies and/or imbalances could have led to the elevated plasma uric acid seen in both the breeder birds and the chicks from breeders fed the seed diet.

TABLE 3. Plasma uric acid (mg/dl) in parakeet breeders and chicks

| Diet Protein, % | A 13.5 | B 18.2 | C 25.0 | D (seed) 13.4 | SEM[1] |
|---|---|---|---|---|---|
| Plasma uric Acid | | | | | |
| Breeders | | | | | |
| Initial | 5.98 | 6.89 | 6.57 | 6.37 | .65 |
| Final | 6.06[a] | 6.77[a] | 7.00[a] | 9.31[b] | .88 |
| Chicks, age | | | | | |
| 21 days | 6.23[a] | 6.32[a] | 6.42[a] | 8.0[b] | .52 |

[1] SEM, % Standard error of the means.
[a-b] Numbers within a measurement (row) with a different superscript letter differ (P<.O5) significantly.

## CONCLUSIONS

Protein requirements for parakeets appear to be low, 13.5% or below, given the amino acid levels used. The protein levels (13.2% to 25%) used in this experiment had no effect on plasma uric acid level in either the breeders or the chicks or on breeding performance or growth. Feeding supplemented seed diets led to lower number of chicks hatched per pair and to elevated plasma uric acid levels in the breeders and chicks. The elevated plasma uric acid seen in the supplemented seed diet may have been the result of amino acid deficiencies and/or imbalances inherent in the seed diet.

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